What is claimed is:

1. A method of identifying a compound that regulates the binding of Pot1 to telomeric DNA, comprising detecting whether a candidate compound regulates the binding of a Pot1 polypeptide to a single-stranded telomeric DNA.

2. The method of Claim 1, wherein the candidate compound is exposed to a Pot1 polypeptide-telomeric DNA complex.

3. The method of Claim 1, wherein the candidate compound is exposed to the Pot1 polypeptide prior to exposure to the telomeric DNA.

4. The method of Claim 1, wherein the step of detecting comprises detecting whether the candidate compound strengthens the interaction between the Pot1 polypeptide and the telomeric DNA.

5. The method of Claim 1, wherein the step of detecting comprises detecting whether the candidate compound stabilizes the interaction between the Pot1 polypeptide and the telomeric DNA.

6. The method of Claim 1, wherein the step of detecting comprises detecting whether the candidate compound weakens the interaction between the Pot1 polypeptide and the telomeric DNA.

7. The method of Claim 1, wherein the step of detecting comprises detecting whether the candidate compound disrupts the interaction between the Pot1 polypeptide and the telomeric DNA.

8. The method of Claim 1, wherein the step of detecting comprises detecting whether the candidate compound interacts with the Pot1 polypeptide or a complex between the Pot1 polypeptide and the telomeric DNA to change the binding constant of the complex between the Pot1 polypeptide and the telomeric DNA.

9. The method of Claim 1, wherein the step of detecting is performed by detecting the ability of the candidate compound to change the amount of a labeled probe comprising a fragment of single-stranded telomeric DNA that interacts with the Pot1 polypeptide.

10. The method of Claim 1, wherein the step of detecting is performed using an electrophoretic mobility shift assay.

11. The method of Claim 1, wherein the step of detecting is performed using a high throughput assay for screening candidate compounds simultaneously.

12. The method of Claim 1, wherein the step of detecting is performed using an isolated cell that recombinantly expresses the Pot1 polypeptide.

13. The method of Claim 1, further comprising testing candidate compounds that regulate the binding of a Pot1 polypeptide to single-stranded telomeric DNA to determine whether the candidate compounds regulate telomere length or integrity throughout repeated divisions in a cell culture system.

14. The method of Claim 1, wherein the Pot1 polypeptide is selected from the group consisting of:

a) a Pot1 polypeptide comprising an amino acid sequence selected from the group consisting of: SEQ ID NO:5, SEQ ID NO:13, SEQ ID NO:15 and SEQ ID NO:17.

b) a Pot1 polypeptide comprising an amino acid sequence that is at least about 85% identical to an amino acid sequence selected from the group consisting of: SEQ ID NO:5, SEQ ID NO:13, SEQ ID NO:15 and SEQ ID NO:17, wherein the polypeptide binds single-stranded telomeric DNA; and

c) a fragment of a Pot1 polypeptide as set forth in (a) or (b), wherein the fragment binds single-stranded telomeric DNA.

15, The method of Claim 1, wherein the Pot1 polypeptide comprises an amino acid sequence that is at least about 90% identical to an amino acid sequence selected from the group consisting of: SEQ ID NO:5, SEQ ID NO:13, SEQ ID NO:15 and SEQ ID NO:17, wherein the polypeptide binds single-stranded telomeric DNA.

16. The method of Claim 1, wherein the Pot1 polypeptide is a fragment of an amino acid sequence selected from the group consisting of: SEQ ID NO:5, SEQ

ID NO:13, SEQ ID NO:15 and SEQ ID NO:17, wherein the fragment binds single-stranded telomeric DNA.

17. The method of Claim 1, wherein the Pot1 polypeptide comprises an amino acid sequence selected from the group consisting of: SEQ ID NO:5, SEQ ID NO:13, SEQ ID NO:15 and SEQ ID NO:17.

18. The method of Claim 1, wherein the Pot1 polypeptide comprises SEQ ID NO:5.

19. The method of Claim 1, wherein the single-stranded telomeric DNA is G-rich.

20. The method of Claim 1, wherein the single-stranded telomeric DNA comprises TTAGGG (positions 1-6 of SEQ ID NO:20) repeats.

21. The method of Claim 1, wherein the single-stranded telomeric DNA comprises a nucleic acid sequence selected from the group consisting of any one of SEQ ID NOs:36-38.

22. The method of Claim 1, wherein the candidate compound is selected from the group consisting of: a small organic molecule, an oligonucleotide, and a non-hydrolyzable DNA analogue.

23. A method of identifying a compound that interferes with the binding of a Pot1 polypeptide to a single-stranded telomeric DNA, comprising determining whether the candidate compound decreases the binding of the Pot1 polypeptide to a single-stranded telomeric DNA molecule in a mixture comprising the single-stranded telomeric DNA molecule, the polypeptide, and the candidate compound.